

**Diagnosis of Living and Fossil Short-necked Turtles of the Genus
Elseya using skeletal morphology**

by

Scott Andrew Thomson

B.App.Sc. University of Canberra

Institute of Applied Ecology

University of Canberra

Australia.

A thesis submitted in fulfilment of the requirements of the Degree of Masters of Applied Science at the University of Canberra.

January 2015

Statement of Contribution

As is the modern trend, a substantial proportion of this thesis has been published or submitted for publication. These papers, which also form the chapters of this thesis, have multiple authors. The following is a statement of contribution to these chapters by me and the other authors.

CHAPTER 2: Thomson, S. & Georges, A. 1996. Neural bones in Australian chelid turtles. *Chelonian Conservation and Biology* 2(1), 82-86

The work contributing to this paper was undertaken by me under the supervision of Dr Arthur Georges who provided advice and guidance on the initial decision to proceed with the work, the design of the study, the science leading to the outcome and the preparation of the publication. The contribution of Arthur Georges, although contributing intellectually, did not exceed that which would be expected of an academic supervisor.

CHAPTER 3: Thomson, S.A., White, A., & Georges, A. 1997. Re-evaluation of *Emydura lavarackorum*: identification of a living fossil. *Memoirs of the Queensland Museum* 42:327–336.

The work contributing to this paper was undertaken by me under the supervision of Dr Arthur Georges who provided advice and guidance on the initial decision to proceed with the work, the design of the study, the science leading to the outcome and the preparation of the publication. Dr Arthur White was the scientist who first described the species reassigned in this paper, and it was only appropriate to provide him the opportunity to discuss the reinterpretation. Arthur White engaged in discussions with me on the basis of reassignment of the fossils and the relevance of the fossils which helped me formulate my ideas. The contribution of Arthur Georges, although contributing intellectually, did not exceed that which would be expected of an academic supervisor.

CHAPTER 4: Thomson, S.A. & Mackness, B. 1999. Fossil turtles from the early Pliocene Bluff Downs Local Fauna, with a description of a new species of *Elseya*. *Transactions of the Royal Society of South Australia* 123:101–105.

The work contributing to this paper was undertaken by me under the supervision of Dr Arthur Georges who provided advice and guidance on the initial decision to proceed with the work, the design of the study, the science leading to the outcome and the preparation

of the publication. At the time, the late Brian Mackness was the principal paleontologist at the Bluff Downs fossil site. He gave me access to the fossils described in the paper and stratigraphic data on the age of the fossils. The contribution of Arthur Georges, although contributing intellectually, did not exceed that which would be expected of an academic supervisor.

CHAPTER 5: Thomson, S.A. 2000. A revision of the fossil chelid turtles (Pleurodira) described by C.W. DeVis (1897). *Memoirs of the Queensland Museum* 43:593–598.

The work contributing to this paper was undertaken by me under the supervision of Dr Arthur Georges who provided advice and guidance on the initial decision to proceed with the work and the preparation of the publication. I am the sole author on this publication, reflecting that the contribution of Arthur Georges and others as acknowledged, was not sufficient to warrant co-authorship.

CHAPTER 6: Thomson, S., Georges, A. & Limpus, C. 2006. A New Species of Freshwater Turtle in the Genus *Elseya* (Testudines: Chelidae) from Central Coastal Queensland, Australia. *Chelonian Conservation and Biology*. 5: 74-86.

The work contributing to this paper was undertaken by me under the supervision of Dr Arthur Georges who provided advice and guidance on the initial decision to proceed with the work, discussed with me his prior molecular work which complemented my morphological work, discussed the science leading to the outcome and assisted with the preparation of the publication. Dr Colin Limpus and Arthur Georges provided the ecological data included in the paper, and provided text for that part of the paper. Apart from that, the contribution of Arthur Georges, although contributing intellectually, did not exceed that which would be expected of an academic supervisor.

CHAPTER 7: Thomson, S. and Georges, A. 2009. *Myuchelys* gen. nov.— a new genus for *Elseya latisternum* and related forms of Australian freshwater turtle (Testudines: Pleurodira: Chelidae). *Zootaxa* 2053:32–42.

The work contributing to this paper was undertaken by me under the supervision of Dr Arthur Georges who provided advice and guidance on the initial decision to proceed with the work, discussed with me his prior molecular work which complemented my morphological work and assisted with the preparation of the publication. The

contribution of Arthur Georges, although contributing intellectually, did not exceed that which would be expected of an academic supervisor.

Anders Rhodin, Russ Mittermeier, Peter Pritchard, Uwe Fritz and Roger Bour provided comment and suggestions on the various chapters provided to them as late draft manuscripts.

.....

Signature of Candidate

Acknowledgements

I thank the many institutions and their curators who kindly supplied specimens used in this study and who provided advice on the many taxonomic side issues that arose during this work. They include Ross Sadler (Australian Museum), Patrick Couper (Queensland Museum), Paul Horner (Northern Territory Museum), Laurie Smith (Western Australian Museum), the late John Legler (University of Utah), Peter Pritchard (Chelonian Research Institute), John Wombey (Australian National Wildlife Collection), Jose Rosado (Museum of Comparative Zoology) and Colin MacCarthy (Natural History Museum).

I also thank the many individuals who assisted with access to particular specimens and provided other assistance over the years, including Uwe Fritz (Senckenberg Dresden, Königsbrücker Landstr.), Gerald Kuchling (University of Western Australia), Roger Bour (Muséum National d'Histoire Naturelle, Paris), John Cann (Sydney), Bill McCord (New York), Mike Archer (University of New South Wales), Arthur White (Sydney) and Rod Kennett (Canberra).

The chapters of this thesis have been published and I wish to thank the various people who co-authored those publications, including Arthur Georges, the late Brian Mackness, Arthur White and Colin Limpus. I also thank those who reviewed those chapters, including Anders Rhodin, Russ Mittermeier, Peter Pritchard, Uwe Fritz and Roger Bour. Also thanks go to Reiner Rehwinkle, Simone Reynolds, Peter Ogilvie and Mike Palmer-Allen for technical support in various parts of this work.

Owing to the circumstances that led to the delays in completing this thesis, I also acknowledge Ross Thompson and others who gave me the opportunity to finish and submit it toward a degree with Masters. Without the opportunities given me and the encouragement of Hussam Zaher (Museu de Zoologia da Universidade de São Paulo) and Arthur Georges, I could not have finished this.

I also thank Arthur Georges for supervising my thesis work, and to Steve Sarre for agreeing to co-supervise the completion of this work after my original second supervisor, Will Osborne, had retired.

Table of Contents

Certificate of Authorship of Thesis	iii
Statement of Contribution	v
Acknowledgements	ix
Table of Contents	xi
List of Figures	xiii
List of Tables.....	xv
Chapter 1: Introduction	1
Chapter 2: Neural Bones in Australian Chelid Turtles.....	11
Introduction	11
Materials and Methods	12
<i>Specimens Examined</i>	12
Results	13
Discussion	14
Chapter 3: Re-evaluation of <i>Emydura lavarackorum</i> : identification of a living fossil	21
Introduction	21
Materials and Methods	22
Results	23
Discussion	25
Appendix A: Specimens Examined.....	34
Chapter 4: Fossil turtles from the early Pliocene Bluff Downs Local Fauna, with a description of a new species of <i>Elseya</i>	35
Introduction	35
Materials and Methods	35
Comparative material	38
Systematics.....	38
Discussion	42
Chapter 5: A revision of the fossil Chelid turtles (Pleurodira) described by C.W. de Vis, 1897... 43	
Introduction	43
Methods.....	44
Systematics.....	44
<i>Elseya uberrima</i> (de Vis, 1897)	44
<i>Rheodytes devisi sp. nov.</i>	48
<i>Chelodina insculpta</i> de Vis, 1897	50
Discussion	52

Chapter 6: A New Species of Freshwater Turtle in the Genus <i>Elseya</i> (Testudines: Chelidae) from Central Coastal Queensland, Australia.....	55
Introduction.....	55
Methods.....	56
Systematics.....	58
Description.....	62
Multivariate Comparisons.....	72
Ecology.....	72
Discussion.....	75
Appendix A: Descriptions of Measurement Used.....	77
Appendix B: Specimens Examined.....	78
Chapter 7: <i>Myuchelys</i> gen. nov. — a new genus for <i>Elseya latisternum</i> and related forms of Australian freshwater turtle (Testudines: Pleurodira: Chelidae).....	81
Introduction.....	81
<i>Myuchelys</i> , gen. nov.	82
Discussion.....	90
Appendix A. Description of Characters and Character analysis.....	91
Chapter 8: Synopsis.....	97
References.....	101
Appendix A. Nomenclatural Changes since the publications in this thesis.....	111

List of Figures

Chapter 2

- Figure 1. Comparative line drawings of the neural bone region of the carapace of *Flaviemys purvisi* and *Myuchelys georgesi*.16
- Figure 2. Comparative line drawings of transverse sections through the first neural of three species of turtle.....17
- Figure 3. Chelid phylogeny with the occurrence of loss of exposed neurals mapped with comparison of differing hypotheses of ancestral and derived states.20

Chapter 3

- Figure 1. Comparative line drawings and photographs of the anterior bridge strut of *Pseudemys*, *Flaviemys* and *Elusor*.26
- Figure 2. Comparative line drawings and photographs of the anterior bridge strut of *Rheodytes*, *Elseya dentata* and *Elseya lavarackorum* (extant).....27
- Figure 3. Comparative line drawings and photographs of the anterior bridge strut of *Elseya lavarackorum* (fossil) and *Emydura subglobosa*.....29
- Figure 4. Comparative line drawings of the anterior dorsal surface of the carapace of *Pseudemys*, *Flaviemys*, *Elusor*, *Rheodytes*, *Elseya dentata* and *Elseya lavarackorum* (extant).30
- Figure 5. Comparative line drawings of the anterior dorsal surface of the carapace of *Elseya lavarackorum* (fossil) and *Emydura subglobosa*; figured also the ventral plastrons of *Elseya lavarackorum* (extant and fossil) and *Elseya dentata*.....32

Chapter 4

- Figure 1. Photographs of the Holotype of *Elseya nadibajagu* sp. nov. in ventral and dorsal view of the carapace and plastron.40

Chapter 5

- Figure. 1. Photographs of the lectotype of *Elseya uberrima*, *Elseya arata* and *Pelocomastes ampla*.....46
- Figure. 2. Comparative line drawings of the Anterior Bridge Struts of *Myuchelys latisternum*, *Elseya dentata* and *Rheodytes leukops*.47
- Figure. 3. Photographs of ventral and dorsal views of the holotype of *Rheodytes devisi* and ventral view of the paratype.49
- Figure. 4. Photograph in ventral view of Lectotype of *Chelodina insculpta* showing large area of the intergular scute on this unit.51

Figure 5. Comparative line drawings of the intergular region of A, <i>Chelodina rugosa</i> and B, <i>Elseya dentata</i>	53
---	----

Chapter 6

Figure 1. Photographs of representative specimens of <i>Elseya albagula</i> , showing a male, female and juvenile.	57
Figure 2. Photographs of the holotype (QMJ81785) and allotype (QMJ28449) of <i>Elseya albagula</i>	59
Figure 3. Map of the distribution of <i>Elseya albagula</i> and its close relatives in Australia	61
Figure 4. Line drawings of the lateral, dorsal and ventral views of the skull of <i>Elseya albagula</i> compared with <i>Elseya lavarackorum</i> , <i>Elseya irwini</i> , and <i>Elseya dentata</i>	64
Figure 5. Line drawings of the dorsal view of the carapace and ventral view of the plastron for <i>Elseya albagula</i> , <i>Elseya lavarackorum</i> , <i>Elseya irwini</i> and <i>Elseya dentata</i>	65
Figure 6. Line drawings of the dorsal view of the carapace for small juveniles of <i>Elseya albagula</i> , <i>Elseya lavarackorum</i> , <i>Elseya</i> sp. [Johnstone], <i>Elseya irwini</i> and <i>Elseya dentata</i>	68
Figure 7. Closeup photograph of the lateral view of the head of the female holotype of <i>Elseya albagula</i> showing the prominent barbels, prominent tomial sheath, prominent scales on the temporal region, and pupil indistinct from iris.....	70
Figure 8. Specimens of <i>Elseya albagula</i> (●), <i>Elseya</i> sp. [Johnstone] (○), <i>Elseya dentata</i> (△), <i>Elseya lavarackorum</i> (□) and <i>Elseya irwini</i> (■) plotted in canonical variate space: (a) females; (b) males. Axis lengths in proportion to the percentage of variation among species centroids explained by the canonical variates.....	73

Chapter 7

Figure 1. Line drawings of ventral views of the skulls of <i>Elseya dentata</i> , <i>Myuchelys latisternum</i> and <i>Emydura macquarii</i> (QM48034) showing the alveolar ridge on the maxillary surface of <i>Elseya dentata</i>	84
Figure 2. Line drawings of dorsal and lateral views of the skulls of <i>Elseya dentata</i> , <i>Myuchelys latisternum</i> and <i>Emydura macquarii</i>	86
Figure 3. A phylogeny for the extant genera of the Australian short-necked Chelidae generated using PAUP* (v64d) as the single most parsimonious tree from the character data presented in Table 1.....	88

List of Tables

Chapter 2:

Table 1. Neural formulae of specimens examined possessing exposed neurals.	14
---	----

Chapter 3:

Table 1. Character Matrix. Distribution of the key character states among taxa.	28
--	----

Chapter 6:

Table 1. Measurements of the type specimens.....	60
--	----

Table 2. Relative measurements of the head for <i>Elseya</i>	63
--	----

Table 3. Relative measurements of the carapace and plastron for <i>Elseya</i>	67
---	----

Table 4. Results of cross-validation for the discriminant analysis of males and females..	74
--	----

Chapter 7:

Table 1. Distribution of character states among taxa utilized in the cladistics analysis.....	83
---	----